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CROP COSTS AND RETURNS IN WEST CENTRAL OHIO

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Summary

A 1958 study of crops grown on a rotation basis in Preble, Miami, Madison, Fayette and Pickaway Counties showed that corn gave a net return of $16.19 an acre; soybeans gave $15.83; and wheat produced a profit of $5.20 an acre on farms having about 220 acres of land. These profits were left even after making a land charge of $16.50 an acre and paying all labor $1.50 an hour. Some farmers made profits that were higher than these figures while others received a smaller return.

This same method of figuring showed that oats produced an average loss of $9.56 an acre. Alfalfa, clover and timothy hay also showed a loss of $2.45 an acre on these farms when only one cutting was made and the meadow was not pastured the remainder of the season.

Profits from two cuttings of hay could not be studied satisfactorily on the 220-acre group of farms because one crop was all that was harvested on most of these farms. However, it was possible to obtain a sufficiently large sample of meadows cut twice by considering all sizes of farms included in the study. Figures for this group of farms, which averaged about 280 acres in size, showed a net profit of $6.95 an acre for two cuttings of hay. Net income from meadows could be further increased by making a third cutting of hay or pasturing profitable livestock after harvesting the second crop.

The average cost of producing an acre of the various crops declined as size of farm increased. However, most of the monetary gains from using large tractors and machinery were obtained when size of farm reached about 400 crop acres. By increasing the number of crop acres per farm from 100 to 700, the total cost of producing an acre of crops was reduced as follows: corn, about 15 percent; soybeans, 17 percent; and wheat and hay, 11 percent.

Cost of production figures show that farmers on small farms can compete with operators of large tracts of land on a unit cost basis if they can use their harvesting equipment efficiently.

Up to harvest time, labor and machinery costs will be only slightly lower for a 280-acre farm than a 160. But harvesting costs may vary considerably. A farmer on a 160-acre farm can reduce the cost of producing an acre of corn about $5.00 by hiring his corn harvested compared with owning a new picker and not using it to do any custom work for neighbors. He also can save about $3.00 an acre by hiring his soybeans and wheat harvested.

On small farms, crop production costs can be kept to the minimum by (1) hiring crops harvested, (2) owning new equipment and doing some custom work for neighbors, or (3) purchasing secondhand harvesting equipment when a new machine would become obsolete before it wears out. If these alternatives are followed on a 160-acre farm, cost of producing crops per acre will be about the same as on a 280-acre farm where all machinery is owned by the operator, and they will be only slightly higher than the costs incurred on a 500-acre farm.

An efficient farmer may not have the lowest possible crop costs on an acre basis. But he will have low costs per bushel of grain or ton of hay produced. The average farmer on a 220-acre farm had the following total crop costs per acre: corn, about $59; soybeans, $44; oats, $45; wheat, $47; and one cutting of hay, $38. Crop costs per acre averaged about 10 percent lower on a 640-acre farm than a 220 when all factors were held constant except size of machinery used.

Objectives

The main objectives of this study were as follows:

1. To determine the amount of man labor, tractor power, machinery, fertilizer, lime, seed and spray material used by farmers to raise and harvest an acre of corn, soybeans, oats, wheat, and hay on different size farms in West Central Ohio.
2. To determine production costs and profits per acre for the various crops when normal yields are obtained.
3. To determine how size of farm affects the cost of producing crops.
4. To determine the amount of time used to perform the various jobs needed to produce farm crops

[1]Assistance was given by J. H. Sitterly and others of the Department of Agricultural Economics and Rural Sociology. Most of the field work was done by Walter Hunnicutt.

when different size tractors and equipment are used.

How Study Was Made

The following data was collected on 124 farms in Preble, Miami, Madison, Fayette and Pickaway Counties for the 1958 crop season: land use, crop yields, livestock numbers and amount of labor, power, equipment, fertilizer, manure, lime, seed, and spray used. The amount of labor, power and machinery used to produce crops was obtained from record books in which the farmers recorded the following information for each crop as the various jobs were performed: acres of land covered, number of man and tractor hours used, number of men in the crew, and size of tractor and machine used for the specific operation. The remainder of the data was collected by personal interviews. Two visits were made to each farm during the growing season, and a final visit was made in November or December after all crops were harvested.

In selecting the farms to be studied, the first step was to list all farms on which the principal soil types were Miami, Celina, Crosby and Brookston. This was done for each of the five counties. The second step was to divide this list of farms into the following size groups: 100-179 acres, 180-259 acres, 260-499 acres and 500-1200 acres. The third step was to draw a random sample of farms from each of the four different size groups. Two substitute farms were also drawn for each farm in the primary sample to be used in cases where farmers from the first drawing did not want to keep the necessary records on labor, power and equipment. These substitute farms were comparable in size with the ones in the primary sample. One hundred twenty-nine farmers started to keep the necessary records, but only 124 finished with the project. Sixty-three percent of the 124 farms came from the primary sample group; 26 percent came from the first substitute group; and 11 percent came from the second substitute group. This procedure permits a possible bias in favor of better record keepers. However, this possible bias must be accepted because of the need for accurate and complete labor, power and machinery records. Some of the farmers did not raise all of the five crops studied, and a few failed to keep adequate records on all of these crops when grown. Therefore, the number of records available for analysis was as follows: corn, 122; soybeans, 70; oats, 84; wheat, 95; and hay, 95.

Description of Farms Studied

Land Use. Acreages of various crops are shown in Table 1 for the four different farm size groups. Each size group had about the same land use pattern. Approximately three-fourths of the total farm area was used for rotated crops. Nearly one-half of the rotated land was planted to corn and soybeans, about 20 percent was sowed to oats and wheat, and the remaining 30 percent was used for hay and rotation pasture. In most cases, meadows were allowed to stand only one year.

Table 1.—Land Use on 124 Farms in West Central Ohio, 1958

Land use	Size of farm in crop acres			
	50-145 (31 farms)	146-207 (31 farms)	208-363 (31 farms)	364-996 (31 farms)
	acres	acres	acres	acres
Corn	43	62	96	208
Soybeans	9	19	29	59
Oats	11	13	23	29
Wheat[1]	13	23	38	81
Hay	19	30	35	85
Rotation pasture	11	22	39	76
Acreage reserve[2]	1	3	3	10
Crop acres	107	172	263	548
Permanent pasture	17	17	36	55
Woods	11	10	11	27
Miscellaneous	11	11	18	25
Total	146	210	328	655

[1]Includes a small amount of barley and rye.

[2]Includes a small amount of land in soil bank.

Livestock Numbers. All except four farms had some kind of livestock. The group of 31 small farms had about 10 percent more livestock per crop acre than the three groups of larger farms. The large farms had fewer dairy cows but more hogs per acre of cropland than the small farms (Table 2). Twenty-nine farmers reported 10 or more dairy cows; 46 farmers kept 10 or more beef cows; and 83 farmers marketed more than 100 fat hogs.

How Receipts Were Calculated

Yields used in calculating gross receipts for an acre of the various crops were as follows: corn, 75 bushels; soybeans, 30 bushels; oats, 55 bushels; wheat, 30 bushels; and hay, 1.8 tons from one cutting and 2.9 tons from two cuttings. These production figures are long term averages of the yields that the farmers said they normally produced.

In calculating gross receipts, the same crop yields were used for the different size farms. Although the reported normal corn yields averaged about five percent higher on the large farms than on the small ones, this difference could have been due to the fact that the large farms had soil that was slightly more productive. Most of the large farms were located in Madison, Fayette, and Pickaway Counties, while a large proportion of the small farms was in Preble and Miami Counties. The reported normal yields of soybeans, oats, wheat, and hay were practically the same for the different size farms.

Prices used to determine receipts for the various crops were as follows: corn, $1.00 a bushel; soybeans, $2.00; oats, $.65; wheat, $1.75; and hay, $20.00 a ton.

How Costs Were Calculated

All costs were based on 1958 production methods and prices. Labor charges, which were calculated at $1.50 an hour, were based on the assumption that the farm operator would provide his own house and food. If a rent-free house and some food were figured as production costs, labor charges could be reduced to about $1.00 an hour. However, this reduction in labor cost would be largely offset by a higher land charge to provide for a dwelling.

Most of the labor used in producing crops was direct field work. However, a small amount of miscellaneous labor was used. This included such jobs as hauling fertilizer from the dealer's delivery point to the farm, getting equipment ready for use, cleaning and storing equipment after use, and making the necessary machinery repairs. The amount of miscellaneous labor charged against each crop was as follows: corn, .5 of an hour; soybeans, oats, wheat and one cutting of hay, .4; and two cuttings of hay, .6 of an hour. No labor or tractor time was charged against the crops for building fences or hauling manure.

Tractor and machinery charges were figured on the basis of size and number of hours used in a year. A detailed list of these charges for different size tractors and equipment and different intensities of use are given in Appendices A and B. The amount of man labor and tractor power used includes the time spent moving equipment to and from fields and the amount of time spent doing the necessary field work.

The entire amount of fertilizer and manure applied to the cropland was charged against the grain crops. No charges for fertilizer and manure were made

Table 2.—Amount of Livestock Kept on Different Size Farms in West Central Ohio, 1958

Class	Size of farm in crop acres			
	50-145 (31 farms)	146-207 (31 farms)	208-363 (31 farms)	364-996 (31 farms)
	number	number	number	number
Dairy cows	6	9	6	7
Beef cows	4	7	11	21
Fat cattle	10	24	26	58
Ewes	12	11	11	28
Lambs	12	13	9	22
Sows	9	11	21	46
Market hogs	112	144	312	684
Hens	112	68	79	77

Table 3.—Receipts, Expenses and Net Income for an Acre of Corn on Different Size Farms, West Central Ohio, 1958

	Size of farm in crop acres			
	50-141 average 105 (30 farms)	142-206 average 170 (31 farms)	207-363 average 201 (31 farms)	364-996 average 545 (30 farms)
Receipts[1]	$75.00	$75.00	$75.00	$75.00
Expenses				
Man labor	10.80	9.95	8.79	8.03
Tractor power	7.51	7.06	6.23	5.48
Machinery	8.89	7.64	7.81	5.98
Fertilizer	10.82	10.38	10.60	11.95
Manure	5.81	5.09	5.18	4.65
Lime	.42	.31	.48	.62
Seed	1.78	1.74	1.80	1.76
Spray	.29	.14	.28	.36
Land	16.50	16.50	16.50	16.50
Total	62.82[2]	58.81	57.67	55.33[2]
Net income	12.18	16.19	17.33	19.67

[1]Seventy-five bushels at $1.00 a bushel.

[2]Differences in cost due to size of farm were significant at the one percent level. Standard deviations in cost for the smallest to the largest farm size groups were as follows: $6.40, $6.24, $6.48 and $6.24.

against the meadow crops. This procedure was based on the assumption that legumes will add at least enough nitrogen in roots and stubble to offset the value of the phosphorus and potash removed by the hay crop.

Two steps were used in calculating fertilizer and manure charges for the grain crops. The first one was to determine the value of all fertilizer and manure applied to the rotated land. The second step was to prorate these costs to the various grain crops and straw when harvested on the basis of the way each crop removes nitrogen, phosphorus and potash from the soil[1]. This method of figuring fertilizer and manure costs gave meadow crops some credit for the nitrogen they store in the soil for succeeding crops. It also gave a better picture of the actual cost of supplying mineral nutrients to the grain crops than could have been shown if a portion of the fertilizer and manure had been charged against the meadow crop.

Fertilizer was charged at actual cost. The analyses most commonly used and their costs per ton were: 3-12-12, $46; 5-20-20, $72; and 12-12-12, $69. Manure was valued at $2.25 a ton when protection was given against rain and snow and $1.25 a ton when no protection was provided.

[1]The amount of plant nutrients removed by different crops is given in the "Handbook of Ohio Experiments in Agronomy", Ohio Agricultural Experiment Station, November, 1957, page 21.

Cost of lime was prorated equally among the various crops grown on the rotated land. Price paid per ton including spreading averaged $3.60 for agricultural ground limestone.

A land charge of $16.50 an acre was figured for each crop. After deducting an annual tax of $2.25 an acre, the remaining land charge allowed a five percent return on a $285 land valuation. This land charge did not include the use of a farm house for the operator. If a dwelling were included, the land charge would have to be higher than $16.50 an acre. The same land charge was used for each farm because of the difficulty of determining the true market value of the cropland for each farm.

Costs and Returns for Different Crops

Corn. This crop was the most profitable one studied. Cost of producing corn on a 210-acre farm averaged about $59 an acre or $.79 a bushel when a 75-bushel yield was obtained. If this grain were sold at $1.00 a bushel, net income would be about $16 an acre after all expenses were paid. Cost of producing an acre of corn declined as size of farm increased (Table 3). For certain size farms, this reduction in costs was due principally to using the same size equipment more intensively. When machinery is used to full capacity, overhead costs per acre can be kept to the minimum for such items as depreciation, obso-

Table 4.—Physical Inputs Used in Producing an Acre of Corn on Different Size Farms, West Central Ohio, 1958

	Size of farm in crop acres			
	50-141 average 105 (30 farms)	142-206 average 170 (31 farms)	207-363 average 201 (31 farms)	364-996 average 545 (30 farms)
Man labor, hours	7.2	6.6	5.9	5.4
Tractor power – 2-plow, hrs.	4.4	3.7	2.1	1.3
Tractor power – 3-plow, hrs.	1.5	1.8	2.4	2.5
Tractor power – 4-plow, hrs,	0	.2	.3	.3
Fertilizer, pounds[1]	451	432	442	498
Manure, tons	3.0	2.5	2.5	2.4
Lime, pounds	220	180	260	340
Seed, pounds	10.5	9.7	10.0	10.4
Spray, pints	.7	.4	.7	.9

[1]Adjusted to a 5-10-10 analysis which cost $48 a ton.

lescence, storage and interest. Larger equipment, when used efficiently, also lowers costs per acre by reducing the amount of man labor and tractor power needed.

The cost of a bushel of seed corn and a gallon of spray material was approximately the same for the different groups of farms. Seed corn averaged $9.80 a bushel and spray, $3.35 a gallon.

Physical inputs used by farmers to produce an acre of corn are given in Table 4. The prorated fertilizer application in pounds was determined by dividing the prorated cost of this item in Table 3 by 2.4 cents which was the cost of a pound of 5-10-10 fertilizer. This analysis was selected because nitrogen, phosphorus and potash were applied to corn in about a 1-2-2 ratio for all farms. Applications of lime are in terms of agricultural ground limestone.

Table 5.—Receipts, Expenses and Net Income for an Acre of Soybeans on Different Size Farms, West Central Ohio, 1958

	Size of farm in crop acres			
	91-153 average 121 (16 farms)	154-221 average 181 (18 farms)	222-399 average 295 (18 farms)	400-920 average 556 (18 farms)
Receipts[1]	$60.00	$60.00	$60.00	$60.00
Expenses				
Man labor	9.04	7.35	6.82	5.83
Tractor power	6.36	4.81	5.29	3.89
Machinery[2]	9.05	7.84	7.62	7.07
Fertilizer	3.16	2.74	3.08	2.87
Manure	1.25	1.25	1.05	1.16
Lime	.53	.54	.57	.47
Seed	2.82	3.14	3.20	3.22
Land	16.50	16.50	16.50	16.50
Total	48.71[3]	44.17	44.13	41.01[3]
Net income	11.29	15.83	15.87	18.99

[1]Thirty bushels at $2.00 a bushel

[2]Includes a truck charge of less than $.50

[3]Differences in cost due to size of farm were significant at the one percent level. Standard deviations in cost for the smallest to the largest farm size groups were as follows: $3.46, $4.24, $3.46 and $2.00.

Soybeans. This crop produced almost as much net income per acre as corn. Cost of producing soybeans on a 220-acre farm averaged about $44 an acre or $1.47 a bushel when a 30-bushel yield was obtained. If this grain were sold at $2.00 a bushel, net income would be almost $16 an acre after paying all costs including a land charge of $16.50 an acre and a labor charge of $1.50 an hour (Table 5). Larger farms produced higher profits because production costs were lower. Cost of soybean seed was about the same per bushel for each group of farms, the average being $2.53.

Physical inputs used by farmers to produce an acre of soybeans are shown in Table 6. The prorated ferti-

Table 6.—Physical Inputs Used in Producing an Acre of Soybeans on Different Size Farms, West Central Ohio, 1958

	Size of farm in crop acres			
	91-153 average 121 (16 farms)	154-221 average 181 (18 farms)	222-399 average 295 (18 farms)	400-920 average 556 (18 farms)
Man labor, hrs.	6.0	4.9	4.5	3.9
Tractor power – 2-plow, hrs.	4.2	2.2	1.3	1.0
Tractor power – 3-plow, hrs.	1.0	1.8	2.1	1.7
Tractor power – 4-plow, hrs.	0	0	.4	.3
Fertilizer, pounds[1]	105	91	103	96
Manure, tons	.6	.6	.5	.6
Lime, pounds	280	300	320	260
Seed, bushels	1.1	1.2	1.3	1.3

[1]Adjusted to an 0-20-20 analysis which cost $60 a ton

Table 7.—Receipts, Expenses and Net Income for an Acre of Oats on Different Size Farms, West Central Ohio, 1958

	Size of farm in crop acres			
	50-150 average 111 (21 farms)	151-212 average 179 (21 farms)	213-347 average 260 (21 farms)	348-920 average 522 (21 farms)
Receipts[1]	$35.75	$35.75	$35.75	$35.75
Expenses				
Man labor	5.91	6.25	5.28	4.47
Tractor power	4.00	4.34	3.42	2.52
Machinery[2]	7.68	7.42	7.58	6.55
Fertilizer	5.02	4.59	4.76	5.31
Manure	2.30	2.49	2.39	2.08
Lime	.41	.43	.36	.83
Seed	3.15	3.29	2.78	3.32
Land	16.50	16.50	16.50	16.50
Total	44.97[3]	45.31	43.07	41.58[3]
Net income	-9.22	-9.56	-7.32	-5.83

[1]Fifty-five bushels at $.65 a bushel

[2]Includes a truck charge of less than $.25

[3]Differences in cost due to size of farm were significant at the ten percent level. Standard deviations in cost for the smallest to the largest farm size groups were as follows: $5.10, $4.47, $5.10, and $5.00

lizer application in pounds was determined by dividing the prorated cost of this item in Table 5 by 3 cents which was the cost of a pound of 0-20-20 fertilizer. This analysis was selected because soybeans remove nitrogen, phosphorus and potash from the soil in about a 0-1-1 ratio.

Oats. This is the only grain crop that did not pay all costs of production. Cost of producing oats on a 220-acre farm averaged about $45 an acre or $.82 a bushel when a 55-bushel yield was obtained (Table 7). If this grain were sold for $.65 a bushel, an acre of oats would show a loss of about $9.50. However, if the straw could be sold for more than the cost of production, some of this loss could be eliminated. Costs of producing an acre of straw beyond small grain harvest are shown in Table 15. Cost of seed oats averaged $1.41 a bushel.

Physical inputs used by farmers to produce an acre of oats are given in Table 8. The prorated fertilizer application in pounds was determined by dividing the prorated cost of this item in Table 7 by 2.4 cents which was the cost of a pound of 5-10-10 fertilizer. This analysis was selected because nitrogen, phosphorus and potash were applied to oats in about a 1-2-2 ratio for all farms.

Applications of fertilizer and manure in Table 8 represent only the amount prorated to the grain crop. These rates do not include the amount prorated to the straw when harvested and removed from the oat field.

Wheat. Cost of producing wheat on a 230-acre farm averaged about $47 an acre or $1.57 a bushel when a 30-bushel yield was obtained (Table 9). If this grain were sold for $1.75 a bushel, net income would be about $5 an acre. In some cases, this profit might be increased slightly by selling the straw. Cost of seed wheat averaged $2.37 a bushel.

Physical inputs used by farmers to produce an acre of wheat are given in Table 10. Many farmers top-dressed their wheat with fertilizer in the spring. The prorated fertilizer application in pounds was determined by dividing the prorated cost of this item in Table 9 by 2.4 cents which was the cost of a pound of 5-10-10 fertilizer. This analysis was selected because nitrogen, phosphorus and potash were applied to wheat in about a 1-2-2 ratio for all farms. Applications of fertilizer and manure include only the amount prorated to the grain crop.

Hay. Cost of producing hay on a 270-acre farm averaged about $38 an acre or $21 a ton when only one cutting of 1.8 tons was made (Table 11). If this hay were sold for $20 a ton, one cutting and no pasturing the remainder of the season would produce a loss of about $2 an acre in net income.

When two cuttings of hay yielding 2.9 tons per acre were harvested, production costs increased to about $51 an acre or $17.50 a ton for farms averaging about 280 acres in size. This yield produced a profit

Table 8.—Physical Inputs Used in Producing an Acre of Oats on Different Size Farms, West Central Ohio, 1958

	Size of farm in crop acres			
	50-150 average 111 (21 farms)	151-212 average 179 (21 farms)	213-347 average 260 (21 farms)	348-920 average 522 (21 farms)
Man labor, hrs.	3.9	4.2	3.5	3.0
Tractor power — 2-plow, hrs.	1.8	1.9	1.1	.6
Tractor power — 3-plow, hrs.	1.2	1.5	1.3	1.2
Tractor power — 4-plow, hrs.	0	0	.2	.2
Fertilizer, pounds[1]	209	191	198	221
Manure, tons	1.1	1.2	1.2	1.0
Lime, pounds	220	240	200	230
Seed, bushels	2.2	2.2	2.1	2.2

[1]Adjusted to a 5-10-10 analysis which cost $48 a ton

Table 9.—Receipts, Expenses and Net Income for an Acre of Wheat on Different Size Farms, West Central Ohio, 1958

	Size of farm in crop acres			
	50-154 average 120 (24 farms)	155-226 average 189 (24 farms)	227-373 average 285 (24 farms)	374-996 average 560 (23 farms)
Receipts[1]	$52.50	$52.50	$52.50	$52.50
Expenses				
Man labor	5.77	5.80	4.99	4.23
Tractor power	3.74	3.65	2.98	2.53
Machinery[2]	7.80	7.71	7.18	6.47
Fertilizer	6.06	5.63	5.77	7.10
Manure	2.91	2.55	2.34	2.28
Lime	.30	.46	.44	.53
Seed	5.01	5.00	4.84	4.99
Land	16.50	16.50	16.50	16.50
Total	48.09[3]	47.30	45.04	44.63[3]
Net income	4.41	5.20	7.46	7.87

[1]Thirty bushels at $1.75 a bushel

[2]Includes a truck charge of less than $.40

[3]Differences in cost due to size of farm were significant at the five percent level. Standard deviations in cost for the smallest to the largest farm size groups were as follows: $4.00, $5.48, $5.57, and $4.36

of about $7 an acre when the hay was sold for $20 a ton at the farm. Net income could be further increased by making a third cutting or pasturing profitable livestock after harvesting the second crop of hay.

Returns to pasture will depend upon the efficiency of the livestock consuming it. Cost of clover, alfalfa and grass seed would have been about $4.50 an acre if all seed had been purchased and no farm-grown seed had been used.

Table 10.—Physical Inputs Used in Producing an Acre of Wheat on Different Size Farms, West Central Ohio, 1958

	Size of farm in crop acres			
	50-154 average 120 (24 farms)	155-226 average 189 (24 farms)	227-373 average 285 (24 farms)	374-996 average 560 (23 farms)
Man labor, hrs.	3.9	3.9	3.3	2.8
Tractor power – 2-plow, hrs.	2.0	1.8	.7	.7
Tractor power – 3-plow, hrs.	.9	1.2	1.4	1.1
Tractor power – 4-plow, hrs.	0	0	.1	.1
Fertilizer, pounds[1]	252	235	240	296
Manure, tons	1.5	1.3	1.2	1.1
Lime, pounds	160	260	240	300
Seed, bushels	2.2	2.1	2.0	2.1

[1]Adjusted to a 5-10-10 analysis which cost $48 a ton

Table 11.—Receipts, Expenses and Net Income for an Acre of Hay on Different Size Farms, West Central Ohio, 1958

	One cutting			Two cuttings
	Crop acres 63-158 average 124 (23 farms)	Crop acres 159-320 average 225 (23 farms)	Crop acres 321-996 average 537 (23 farms)	218 crop acres per farm (26 farms)
Receipts	\$36.00[1]	\$36.00[1]	\$36.00[1]	\$58.00[2]
Expenses				
Man labor	6.60	6.69	5.71	11.56
Tractor power	2.52	2.66	2.70	5.01
Machinery	7.61	5.86	5.42	11.31
Fertilizer & manure	0	0	0	0
Lime	.25	.39	.68	.41
Seed	4.30	4.28	3.55	4.30
Spray	.22	.13	.47	.12
Twine and wire	1.20	1.19	1.25	1.84
Land	16.50	16.50	16.50	16.50
Total	39.20[3]	37.70	36.28[3]	51.05
Net income	-3.20	-1.70	-.28	6.95

[1] 1.8 tons at \$20 a ton

[2] 2.9 tons at \$20 a ton

[3] Differences in cost due to size of farm were significant at the five percent level. Standard deviations in cost for one cutting of hay for the smallest to the largest farm size groups were as follows: \$5.00, \$2.83 and \$2.45

Physical inputs used by farmers to produce an acre of hay are shown in Table 12. The average rate of seeding an acre of meadow was as follows: alfalfa, 5.2 pounds; red clover, 4.6 pounds; alsike, .2 pounds; ladino, .2 pounds; timothy, 2.7 pounds; and bromegrass, .3 pounds. Cost of spray averaged \$3.20 a gallon.

Corn Silage. The average cost of producing an acre of corn silage on 26 farms is shown in Table 13 Cost of producing an acre of corn for grain on the same farms is also given for comparative purposes. Cost of producing a ton of corn silage averaged \$7.02 for a yield of 12 tons per acre. To produce this amount of silage required 4.0 more hours of man labor and

Table 12.—Physical Inputs Used in Producing an Acre of Hay on Different Size Farms, West Central Ohio, 1958

	One cutting			Two cuttings
	Crop acres 63-158 average 124 (23 farms)	Crop acres 159-320 average 225 (23 farms)	Crop acres 321-996 average 537 (23 farms)	218 crop acres per farm (26 farms)
Man labor, hrs.	4.4	4.4	3.8	7.7
Tractor power – 2-plow, hrs.	1.8	1.4	1.0	2.8
Tractor power – 3-plow, hrs.	.3	.6	1.1	1.3
Tractor power – 4-plow, hrs.	0	.2	.1	0
Lime, pounds	140	220	380	220
Clover and alfalfa seed, pounds	10.6	10.7	9.1	10.6
Grass seed, pounds	2.9	2.8	3.3	3.0
Spray, pint	.6	.3	1.0	.4

3.7 more hours of tractor power than 75 bushels of corn harvested as grain.

The prorated fertilizer charge for an acre of corn silage was $17.50. This charge would purchase about 730 pounds of a 5-10-10 analysis. The prorated manure charge was 4.75 tons per acre.

Table 13.–Comparison of Costs of Producing an Acre of Corn for Grain and Silage on 26 Farms,[1] West Central Ohio, 1958

	Corn for grain (75 bu. yield)	Corn for silage (12 ton yield)
Man labor	$ 8.25	$14.25
Tractor	6.09	10.74
Machinery	7.58	13.33
Fertilizer	11.96	17.50
Manure	6.50	9.50
Lime	.38	.38
Seed	1.77	1.77
Spray	.25	.25
Land	16.50	16.50
Total	59.28	84.22
Cost per unit	.79 per bu.	7.02 per ton

[1]These farms ranged in size from 153 to 1170 acres; median size was 336 acres.

Table 14.–Comparison of Costs of Producing an Acre of Hay and Grass Silage on 8 Farms,[1] West Central Ohio, 1958

	Hay[2] (1.8 T from 1st cutting)	Grass silage[2] (6 T from 1st cutting)
Man labor	$ 6.87	$ 6.84
Tractor	2.90	4.31
Machinery	4.90	6.60
Fertilizer and manure	0	0
Lime	.59	.59
Seed	2.88	2.88
Spray	.45	.45
Twine and wire	1.18	0
Land	10.23	10.23
Total	30.00	31.90
Cost per ton	16.67	5.32

[1]These farms ranged in size from 125 to 1170 acres; median size was 565 acres

[2]Lime, seed, spray and land charges were prorated on the basis of 2.9 tons of hay from two cuttings

Grass Silage. The average cost of producing an acre of grass silage and hay from the first cutting of meadow growth on 8 farms is shown in Table 14. Cost of producing a ton of grass silage averaged $5.32 for a yield of 6 tons per acre when the succeeding growth was harvested as hay. In calculating these costs, charges for lime, seed, spray and land were prorated on the basis of a hay yield of 2.9 tons from two cuttings. If grass silage were made from the first cutting of meadow and the succeeding growth were neither harvested as hay nor pastured by livestock, cost of producing a ton of grass silage would be about $6.75. Six tons of grass silage per acre required about the same amount of man labor as 1.8 tons of hay. But an acre of grass silage required 1.1 hours more tractor power than an acre of hay.

Straw. The additional cost of producing an acre of straw beyond small grain harvest was $16.04 for a 1.0 ton yield (Table 15). This figure includes a prorated fertilizer charge which would pay for about 85 pounds of a 5-10-10 analysis and a prorated manure charge for .7 of a ton per acre. It does not include any charge for the use of the land because this item was charged completely against the oat and wheat crops. Man labor used per acre amounted to 3.2 hours. Power requirements averaged 1.2 hours for a two-plow tractor and .6 of an hour for a three-plow tractor.

Table 15.–Cost of Producing an Acre of Straw Beyond Small Grain Harvest on 64 Farms, West Central Ohio, 1958

	Cost per acre[1] (1.0 ton yield)
Man labor	$ 4.77
Tractor	2.24
Machinery	4.83
Twine and wire	.70
Fertilizer[2]	2.05
Manure[2]	1.45
Total	16.04

[1]All land costs were charged against the oat and wheat crops

[2]These charges were calculated by the same method that was used to prorate fertilizer and manure charges for the grain crops

How Size of Farm Affects Crop Costs

Preceding figures do not show exactly how size of farm influenced crop costs because all other factors did not remain the same as size of farm increased.

For example, the amount of fertilizer and manure applied per acre to corn averaged slightly higher on the farms in the bottom and top quartiles than on the tracts of land in the second and third quartiles. Similar variations also occurred in other cost items.

Figure 1 shows the relationships between crop costs and size of farm when charges for fertilizer, manure, lime, seed, spray and use of the land were held constant on the individual farms[1]. In this procedure, the average charge for these items was used instead of the actual costs. This method of analysis was used so that any changes in cost could be attributed soley to differences in size of farm and equipment used.

Costs of producing an acre of corn, soybeans, wheat and hay declined as size of farm increased (Figure 1). This is particularly noticeable for farms having less than 400 crop acres. For example, the cost of producing an acre of corn declined $6.55 when size of farm was increased from 100 to 400 crop acres. But a further decline of only $2.45 an acre occurred when size of farm was increased from 400 to 700 crop acres. In other words, most of the monetary gains from using large tractors and machinery were obtained when size of farm reached about 400 crop acres. This was due to the fact that size of machines and intensity of use did not increase much on farms above this acreage. By increasing the number of crop acres per farm from 100 to 700, the total cost of producing an acre of the various crops was reduced as follows: corn about 15 percent; soybeans, 17 percent; and wheat and hay, 11 percent.

Why Costs Decline. An increase in crop acres from 100 to 700 reduced the average cost of producing an acre of corn about $9.00. About $3.30 of this amount was due to lower machinery charges; $2.35 was due to lower tractor costs; and $3.35 was attributed to lower labor requirements.

Cost of producing an acre of soybeans was reduced about $8.00 by increasing the area in cultivated crops from 100 to 700 acres. This reduction in costs came from the following sources; machinery, $2.15; tractor power, $2.45; and labor, $3.40.

Cost of producing an acre of wheat was reduced about $5.50 when size of farm was increased from 100 to 700 crop acres. These savings were distributed as follows: machinery, $1.75; tractor power, $1.70; and labor, $2.05.

This same increase in farm size reduced the cost of producing one cutting of hay about $4.40 an acre. Machinery charges were reduced about $2.85; tractor charges, $.55; and labor charges, $1.00 an acre.

[1]A detailed analysis of the way these curves were determined is given in Appendix C. Similar cost curves were determined for labor, tractor power and machinery.

The cost of using each piece of machinery was calculated from the hourly rates shown in Appendix B. Cost per hour was calculated on the basis of size of machine and number of hours it was used annually. These figures showed higher hourly costs as size of equipment increased. But on an acre basis, machinery charges were about the same regardless of machine size, provided each piece of equipment was used the same number of hours. In other words, as size of machine increased, savings in time amounted to enough to keep machinery charges approximately the same on an acre basis if hours of use remained the same. Therefore, reductions in machinery costs for all crops can be attributed mainly to a more intensive use.

Figures in Appendix B show that costs of using most pieces of machinery decline quite rapidly until use exceeds 100 hours a year. However, many farmers on the small farms did not use their harvesting equipment this intensively. On the 160-acre farms, about one-fourth of the farmers used their corn pickers less than 50 hours a year. But on the 660-acre farms, about 85 percent of the farmers used their corn pickers more than 100 hours a year. On the 160-acre farms, about one-half of the farmers used their combines less than 50 hours a year. But on the 660-acre farms, over half of the farmers used their combines more than 100 hours annually. Hay balers were used only a few more hours a year on the large farms than on the small ones because acres of hay harvested were about the same regardless of farm size. Over one-fourth of the farmers on the small and large farms used their hay balers less than 50 hours a year. Only 10 percent of the farmers on the large farms used their balers more than 100 hours annually. Figures on machinery use include all custom work done on other farms.[1]

One reason why machinery charges declined less for soybeans and wheat than for corn and hay was that self-propelled combines were used on the large farms to harvest soybeans and wheat, but no self-propelled equipment was used for hay, and only a few self-propelled pickers were used to harvest corn. On the small farms, most pieces of machinery were pulled by a tractor. In calculating costs of using self-propelled equipment, no attempt was made to separate the power unit from the rest of the machine in figuring charges because of the difficulty involved in allocating joint costs accurately. Therefore, the entire cost of using self-propelled equipment was placed in the machinery charge. This procedure produced slightly higher machinery costs but lower tractor charges than pull-type equipment would have produced.

[1]A more detailed analysis of the use of harvesting equipment is given in Appendix D.

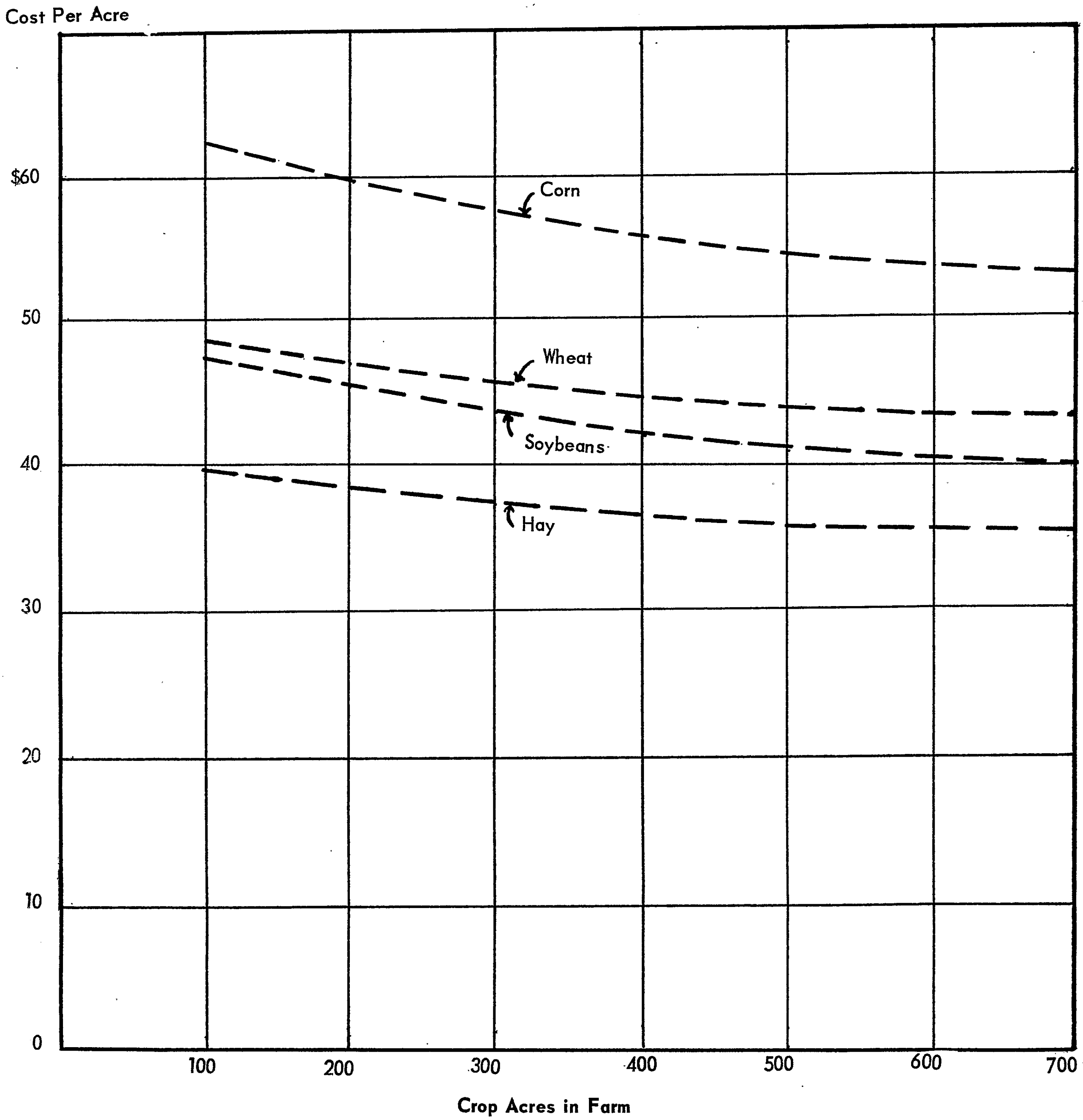

Figure 1.--Relationship between size of farm and cost of producing an acre of corn, soybeans, wheat, and hay on a group of farms in West Central Ohio in 1958.

Tractor costs declined as size of farm increased because of more intensive use and larger size tractors. Also, on the large farms, small reductions in tractor charges occurred because of using self-propelled harvesting equipment which required no additional power for operation. This was especially true for soybeans and wheat.

Tractor charges in Appendix A show that costs per hour of use decline as annual use increases. However, many farmers on the small farms did not use their tractors enough to obtain maximum efficiency. On the 160-acre farms, about three-fourths of the farmers used their tractors 350 hours or less per year. But on the 660-acre farms, about one-half of the farmers used their tractors 500 or more hours a year. These figures are based on tractor equivalents which take into consideration the age of the tractor. For example, tractors less than 13 years of age were given a tractor equivalent rating of one; but tractors 21 years old and over were given a rating of only one-tenth.[1] To illustrate how tractor costs decline as use increases, hourly charges for a three-bottom plow tractor were $1.60 when used 350 hours a year and $1.30 when used 600 hours annually.

Labor costs for corn, soybeans and wheat declined substantially as size of farm increased because larger equipment reduced the amount of time required to perform a specific job. But for hay, labor charges did not decline much as more acres were added to the farming unit because the same size mower, rake and approximately the same size baler were used regard less of farm size.

A more intensive use of equipment lowers tractor and machinery costs per acre. However, this does not affect labor charges per acre for producing crops because they are generally reduced by using larger tractors and machinery. For example, if the same size machinery were used to plow 50 acres of land per year in one case and 100 acres in another, labor charges per acre would be approximately the same for each situation. But machinery costs per acre would be lower for the 100-acre tract than the 50 because of a more intensive use of equipment.

This study showed that a large part of the profits from adding more land to the farming unit came from increasing volume of business rather than reducing costs per acre. For example, if a farmer increased the size of his farm from 100 to 300 crop acres, he would reduce the cost of producing an acre of corn only $4.83 or about 8 percent. But he would increase his gross receipts from corn three times.

[1]A more detailed analysis of the use of tractors is given in Appendix E.

To be more specific, suppose this same farmer followed a rotation of corn, soybeans, wheat and one year of hay. If he operated only 100 acres of cropland, he would have 25 acres in each crop. But if he increased the size of his farm to 300 crop acres, he would have 75 acres in each crop. If he raised 75 bushels of corn per acre and sold it for $1.00 a bushel, his gross receipts from corn would be $75 an acre. If he raised only 25 acres of corn, his profits would be $12.96 an acre or $324 for all corn raised. But if he raised 75 acres of corn, his profits would be $17.79 an acre or $1334 for the entire crop. By trebling the acreage of corn, net income would be increased $362 by reducing costs $4.83 an acre. But the increased volume of business would add $648 more to profits. These figures help explain why commercial farms are increasing in size. Many farmers can afford to increase size of farm and use larger machinery even if unit costs should remain the same.

How to Reduce Costs on Small Farms

This study showed that total machinery costs depended largely on how efficiently the harvesting equipment was used. For example, corn pickers and combines were responsible for about 50 percent of the machinery charges for producing corn, soybeans and wheat on 300-acre farms. On smaller farms, harvesting equipment made this percentage even higher.

Cost of production figures in Table 16 show that farmers on small farms can compete with operators of large tracts of land on a unit cost basis if they can use their harvesting equipment efficiently. A farmer on a 160-acre farm can reduce the cost of producing an acre of corn about $5.00 by hiring his corn harvested compared with owning a new picker and not using it to do any custom work for neighbors. He also can save about $3.00 an acre by hiring his soybeans and wheat harvested.[1] These calculations are based on budget analysis which held all charges constant except labor, tractor power and machinery costs. The following alternatives may be used on small farms to hold crop production costs to the minimum: (1) hire crops harvested; (2) buy new harvesting equipment and do enough custom work on other farms to use the machine at least 100 hours a year; or (3) purchase secondhand harvesting equipment when a new machine would become obsolete before it wears out. If these alternatives are followed on a 160-acre farm, cost of producing crops per acre will be about the same as on a 280-

[1]A more detailed analysis is given in Appendices F, G, and H.

Table 16.–Calculated Costs of Producing Crops on Different Size Farms, with and without Custom Work, West Central Ohio, 1958

	160-acre farm		280-acre farm	500-acre farm
Crop	No machine work hired	Harvesting of crops hired	No machine work hired	No machine work hired
Corn	$63.10	$57.70	$59.50	$55.40
Soybeans	47.90	45.00	44.95	42.25
Wheat	46.65	43.70	44.25	43.15

acre farm where all machinery is owned by the operator, and they will be only slightly higher than the costs incurred on a 500-acre farm. These conclusions are based on the assumption that crops will be harvested about the right time when custom work is used. If this cannot be done and part of the crop is lost, some of the potential gains from hiring crops harvested would be reduced. Although there are conditions under which crop costs may be kept low on small farms, operators of these units will still have considerable difficulty making a satisfactory income from crops alone because volume of business will be too small.

Production costs in Figure 1 were based on average figures for a number of farms that varied in size. This procedure should produce relatively smooth cost curves for each crop compared with the ones an individual farmer would have as he added more land to his farming unit. For a particular farmer, crop production costs might rise or fall substantially as size of farm increased because most pieces of machinery cannot be added in small increments. But for a group of farms, cost curves would tend to be relatively smooth for a number of reasons. Since rotations are not the same on all farms, each piece of machinery will not be used the same number of hours on a given acreage. This will produce variations in unit costs. Machinery costs also will vary for a particular size farm because some farmers will hire more work done than others. The amount of custom work done for neighbors will vary considerably for farms of the same size. Some farmers will rely more on the use secondhand equipment than others. All farmers do not change to larger size machinery when their farming units reach a particular size. Some will use a given size machine on a much larger acreage than others before shifting to a larger piece of equipment.

Crop Costs under Good Management

A good crop farmer may not have the lowest possible crop costs on an acre basis because of heavy expenditures for fertilizer and lime and higher harvesting charges. But he will have low costs per bushel of grain or ton of hay produced. If the lowest possible costs per acre were the goal, a farmer would plant his crops on poor land and would use no fertilizer, manure or lime. Many crop expenses do not increase in the same proportion as yields. On an acre basis, costs of plowing, disking, planting and cultivating are about the same regardless of the size of yield obtained.

On the basis of the average yields that were normally obtained by the farmers in this study, the question might be asked whether crop costs could be reduced below the figures shown for the group of farms averaging 548 acres of cropland. Larger equipment or a more intensive use of present machinery might reduce costs slightly. However, a detailed analysis of size of equipment and intensity of use for the group of farms with the largest acreage showed that crop costs per acre were about as low as could be expected with average yields and present methods of farming. This same conclusion can be drawn from the budgeted costs for the 500-acre farm shown in Appendices F, G and H. The average use for each tractor was about 500 hours a year on the farms averaging 548 crop acres. Crop work was done with the following size tractors: 2-plow, 31 percent; 3-plow, 61 percent; and 4-plow, 8 percent. The average size of machinery used was as follows: plow, 3.2 bottoms; corn planter, 4.1 rows; cultivator, 3.7 rows; corn picker, 2.0 rows; grain drill, 8.8 feet; and combine, 9.5 feet. The average use of the corn picker was 165 hours; the combine, 105 hours; and the hay baler, 70 hours a year. A more intensive use of harvesting equipment would reduce total costs per acre slightly. But receipts might be reduced in some cases because of losses which occur when crops are not harvested at the proper time.

High yields produced lower costs for a bushel of grain and a ton of hay than the average yields for all farms in the study. For example, corn was produced for about $.65 a bushel when yield per acre was 90 bushels and size of farm was about 640 acres compared with $.74 a bushel for a 75 bushel yield. When soybeans produced 35 bushels per acre, cost per bushel was about $1.25 compared with $1.37 a bushel for a 30 bushel yield. Thirty-five bushels of wheat per acre were produced for about $1.35 a bushel compared with $1.49 a bushel for a 30 bushel yield. One cutting of hay was produced for about $15.50 a ton when the yield was 2.5 tons per acre compared with $20 a ton for a 1.8 ton yield. High yields is one of the most effective ways of reducing unit costs on any size farm.

Limitations of Individual Crop Costs

In this study, an attempt was made to determine the cost of producing an acre of the major crops grown in West Central Ohio. This procedure involved the allocation of several joint costs to the various crops raised on a particular farm. Regardless of the way these costs are distributed, the method used can always be questioned. For example, what percent of the cost of fertilizer, manure and lime should be charged against the crops on which they are applied and what percent should be charged to succeeding crops? Will this percentage be the same for different size applications? How much is a ton of manure worth from the standpoint of improving soil structure and adding organic matter? Should the same land charge be made for each crop when some crops show greater profits than others? Since many questions of this type cannot be answered precisely, physical inputs have been given so that costs can be calculated in other ways if the need arises.

In determining which crops are to be grown, consideration also should be given to other factors besides the relative profits per acre as they were calculated in this study. For example, oats lost money when the same land charge was made for each crop. However, some kind of companion crop in establishing meadows is usually raised to maximize income for the rotation as a whole. In some cases, oats may be more profitable than wheat that is sowed too late in the fall. In other cases, government allotments may force some farmers to raise oats on some of the land that otherwise would have been used for wheat. In some areas, better meadows are obtained when seeded with oats than with wheat. Although meadows do not appear to be as profitable as corn and soybeans, consideration also should be given to the fact that a certain amount of meadow crop is needed on most farms to maintain organic matter, improve soil tilth and control erosion. Otherwise, corn and soybean yields might decline to an unprofitable level.

Individual crop costs can be used to indicate roughly which crops should be grown to maximize net income. But a more accurate analysis is possible when crop costs and returns are studied on a rotation basis. This procedure eliminates the need for allocating joint costs among the various crops. It also considers the yield-increasing effects of meadows on succeeding grain crops.

Man Labor and Tractor Power Used for Specific Crop Work

The amount of man labor and tractor power used to perform the various jobs needed to produce crops is shown in Table 17. These time requirements are stated in two ways: one is an average figure that shows the amount of time reported by the median farmer in each job group; the other shows the range in the amount of time used by the middle 50 percent of the farmers to perform a particular job.

The amount of work accomplished in a given time with a certain size machine varied considerably because of differences in the rate of speed machines were used, equipment breakdowns, amount of time needed to move machines to and from fields, weather, yields and size of fields. About 5 percent less labor and power were needed to plow sod and plant and harvest corn when size of field averaged 35 acres instead of 13.[1]

The amount of labor and power used to combine oats and wheat may be somewhat above the normal requirements because of an extremely wet harvesting season in 1958. Heavy rains in July caused some of the small grains to lodge and softened the soil enough that many combines could not operate at their normal speed. Above normal rainfall also increased the number of times combining operations had to be started and stopped.

[1]A more detailed analysis of the effects of field size on time requirements is given in Appendix I.

Table 17.–Labor and Power Used per Acre to Do Various Jobs Needed to Produce Crops, West Central Ohio, 1958

Operation	Number of cases	Size of tractor in plows	Size of machine operated	Man-hours used per acre[1] Average	Range for middle half of farms
Plow sod	32	2	2-14"	1.27	1.12-1.48
Plow stubble	20	2	2-14"	1.23	1.10-1.35
Plow sod	7	3	2-14"	1.04	.95-1.13
Plow stubble	6	3	2-14"	1.15	1.03-1.25
Plow sod	11	3	3-12"	1.00	1.00-1.05
Plow stubble	7	3	3-12"	1.00	1.00-1.00
Plow sod	62	3	3-14"	.92	.75-1.00
Plow stubble	47	3	3-14"	.91	.78-1.00
Plow sod	13	4	4-14"	.58	.50- .67
Plow stubble	11	4	4-14"	.51	.48- .54
Disk	52	2	7 ft.	.39	.35- .50
Disk	46	3	7 ft.	.38	.32- .44
Disk	40	2	8 ft.	.43	.35- .55
Disk	96	3	8 ft.	.34	.31- .40
Disk	40	3	9 ft.	.31	.27- .41
Disk	49	3	10 ft.	.30	.25- .34
Disk	10	4	10 ft.	.25	.20- .29
Disk	8	4	12 ft.	.24	.21- .25
Disk	3	4	14 ft.	.25	.25- .26
Drag	12	2	10 ft.	.39	.33- .50
Drag	13	2	12 ft.	.36	.28- .39
Drag	20	3	12 ft.	.28	.24- .31
Drag	11	2,3,4	14 ft.	.22	.19- .32
Plant corn – 40" rows	37	2,3	2 row	.56	.45- .66
Plant corn – 40" rows	57	2,3	4 row	.29	.25- .37
Plant soybeans – 40" rows	18	2,3	2 row	.53	.43- .65
Plant soybeans – 40" rows	35	2,3	4 row	.28	.25- .34
Plant corn – 38" rows	6	2,3	2 row	.47	.41- .69
Plant corn – 38" rows	8	2,3	4 row	.31	.25- .44
Plant corn – 42" rows	6	2,3	2 row	.55	.38- .63
Plant corn – 40" rows	2	3	6 row	.17	.15- .19
Rotary hoe corn – 40" rows	52	2,3	2 row	.25	.23- .31
Rotary hoe soybeans 40" rows	14	2,3	2 row	.30	.24- .35
Rotary hoe corn – 40" rows	35	2,3	4 row	.15	.13- .18
Rotary hoe soybeans – 40" rows	14	2,3	4 row	.15	.13- .18
Cultivate corn – 1st time	78	2,3	2 row	.50	.46- .56
Cultivate soybeans – 1st time	37	2,3	2 row	.59	.42- .63
Cultivate corn – 2nd time	25	2,3	2 row	.41	.35- .50
Cultivate soybeans – 2nd time	8	2,3	2 row	.47	.36- .56

Table 17.–Continued–Labor and Power Used per Acre to Do Various Jobs Needed to Produce Crops, West Central Ohio, 1958

				Man-hours used per acre[1]	
Operation	Number of cases	Size of tractor in plows	Size of machine operated	Average	Range for middle half of farms
Combine soybeans	7	2,3	5 ft.	1.04	1.00-1.14
Combine soybeans	23	2,3	6 ft.	.80	.67-1.00
Combine soybeans	11	2,3	7 ft.	.84	.70-1.00
Combine soybeans	4	SP[13]	9 ft.	.68	.60- .76
Combine soybeans	10	SP	10 ft.	.52	.46- .60
Combine soybeans	12	SP	12 ft.	.43	.40- .50
Combine oats	15	2,3	5 ft.	1.13	1.00-1.33
Combine oats	22	2,3	6 ft.	1.00	.81-1.09
Combine oats	14	2,3	7 ft.	.85	.60-1.05
Combine oats	3	SP	9 ft.	.54	.52- .58
Combine oats	6	SP	10 ft.	.40	.32- .64
Combine oats	14	SP	12 ft.	.42	.31- .50
Combine wheat	18	2,3	5 ft.	1.02	.90-1.35
Combine wheat	33	2,3	6 ft.	.89	.67-1.05
Combine wheat	15	2,3	7 ft.	.91	.80-1.00
Combine wheat	2	SP	9 ft.	.57	.46- .67
Combine wheat	9	SP	10 ft.	.44	.37- .54
Combine wheat	14	SP	12 ft.	.42	.36- .50
Haul & store soybeans – 23 bu.	13	2,3	----	.67	.44-1.00
Haul & store soybeans – 33 bu.	14	2,3	----	.78	.38-1.00
Haul & store oats – 44 bu.	38	2,3	----	.73[4]	.58-1.19[14]
Haul & store oats – 68 bu.	27	2,3	----	.91[5]	.50-1.18[14]
Haul & store wheat – 25 bu.	23	2,3	----	1.00[6]	.67-1.11[14]
Haul & store wheat – 35 bu.	27	2,3	----	.88[7]	.50-1.00[14]
Combine soybeans – 24 bu.	32	2,3	5-12 ft.	.67	.55-1.00
Combine soybeans – 33 bu.	32	2,3	5-12 ft.	.76	.50-1.00
Combine oats – 43 bu.	41	2,3	5-12 ft.	.77	.53-1.09
Combine oats – 69 bu.	28	2,3	5-12 ft.	.83	.50-1.08
Cultivate corn – 1st time	44	2,3	4 row	.26	.23- .33
Cultivate soybeans – 1st time	21	2,3	4 row	.25	.21- .33
Cultivate corn – 2nd time	21	2,3	4 row	.25	.22- .31
Pick corn – 51 bu.	15	2,3	1 row	1.70	1.36-2.00
Pick corn – 79 bu.	14	2,3	1 row	1.61	1.36-2.00
Pick corn – 54 bu.	43	2,3	2 row	.81	.66-1.00
Pick corn – 81 bu.	29	2,3	2 row	.99	.72-1.03
Haul & store corn – 54 bu.	57	2,3	---	1.00[2]	.78-1.83[14]
Haul & store corn – 82 bu.	46	2,3	---	1.36[3]	.97-2.00[14]

Table 17.--Continued--Labor and Power Used per Acre to Do Various Jobs Needed to Produce Crops, West Central Ohio, 1958

Operation	Number of cases	Size of tractor in plows	Size of machine operated	Man-hours used per acre[1] Average	Man-hours used per acre[1] Range for middle half of farms
Combine wheat -- 23 bu.	35	2,3	5-12 ft.	.80	.64-1.10
Combine wheat -- 35 bu.	55	2,3	5-12 ft.	.86	.50-1.00
Sow oats	19	2,3	12x 7 in.	.44	.42- .70
Sow oats	32	2,3	13x 7 in.	.49	.41- .53
Sow oats	6	2,3	15x 7 in.	.45	.31- .63
Sow oats	12	2,3	16x 7 in.	.43	.30- .58
Sow oats	11	2,3	17x 7 in.	.38	.25- .50
Sow wheat	23	2,3	12x 7 in.	.64	.45- .80
Sow wheat	41	2,3	13x 7 in.	.52	.42- .65
Sow wheat	10	2,3	15x 7 in.	.49	.40- .57
Sow wheat	11	2,3	16x 7 in.	.51	.37- .56
Sow wheat	15	2,3	17x 7 in.	.35	.28- .37
Mow hay -- 1.2 tons	57	2,3	7 ft.	.50	.35- .53
Mow hay -- 1.9 tons	64	2,3	7 ft.	.50	.35- .57
Mow straw -- 1.0 ton	66	2,3	7 ft.	.48	.35- .60
Rake hay -- 1.3 tons	47	2,3	7 ft.	.40	.33- .50
Rake hay -- 1.9 tons	51	2,3	7 ft.	.42	.33- .50
Rake straw -- 1.0 ton	62	2,3	7 ft.	.49	.35- .50
Bale hay -- 1.3 tons	48	2,3	---	.50	.38- .71
Bale hay -- 2.0 tons	54	2,3	---	.50	.43- .67
Bale straw -- 1.0 ton	67	2,3	---	.44	.35- .50
Haul & store hay -- 1.2 tons	53	2,3	---	1.72[8]	1.12-2.40[14]
Haul & store hay -- 2.0 tons	58	2,3	---	2.04[9]	1.50-2.90[14]
Haul & store straw -- .6 ton	33	2,3	---	1.16[10]	.65-1.50[14]
Haul & store straw -- 1.1 tons	42	2,3	---	1.42[10]	1.00-2.30[14]
Chop corn silage -- 10 tons	14	3	---	1.40	1.01-1.92
Haul & store corn silage -- 10 tons	14	2,3	---	4.25[11]	3.55-5.10[14]

Table 17.—Continued—Labor and Power Used per Acre to Do Various Jobs Needed to Produce Crops, West Central Ohio, 1958

Operation	Number of cases	Size of tractor in plows	Size of machine operated	Man-hours used per acre[1] Average	Man-hours used per acre[1] Range for middle half of farms
Chop, haul & store grass silage – 6 tons	8	2,3	– – –	3.40[12]	2.00-3.75[14]
Spray	34	2,3	6 row	.17	.15- .23
Spray	15	2,3	7 row	.16	.13- .21
Spray	10	2,3	8 row	.15	.13- .17
Spread fertilizer	12	2,3	10 ft.	.23	.18- .27
Spread fertilizer	4	2,3	12 ft.	.24	.20- .29
Seed meadow – broadcast	46	2,3	– – –	.16	.12- .20

[1]Number of tractor and machine hours used per acre is also the same as the number of man-hours unless otherwise stated.

[2]Tractor time, .81 hour.

[3]Tractor time, .91 hour.

[4]Tractor time, .60 hour.

[5]Tractor time, .81 hour.

[6]Tractor time, .52 hour.

[7]Tractor time, .48 hour.

[8]Tractor time, .50 hour.

[9]Tractor time, .56 hour.

[10]Tractor time, .44 hour.

[11]Tractor time, 3.55 hours.

[12]Tractor time, 3.10 hours.

[13]SP stands for self propelled.

[14]These range figures apply only to man-hours.

Appendix Table A.–Tractor Charges Used in Calculating Crop Costs[1]
(Based on size of tractor and hours of use)

	Cost per hour when used					
Size	300 hrs. per year	400 hrs. per year	500 hrs. per year	600 hrs. per year	700 hrs. per year	800 hrs. per year
2-plow	$1.25	$1.10	$1.00	$ .90	$ .80	$ .75
3-plow	1.70	1.50	1.40	1.30	1.20	1.15
4-plow	2.15	1.90	1.80	1.70	1.60	1.55

[1]These charges are based on data from the following publications:

"Farm Management Handbook", Department of Agricultural Economics, New York State College of Agriculture, Cornell University, Ithaca, New York. A. E. Ext. 2, December, 1958.

Day, C. L. and M. M. Jones, "Farm Tractor Costs," University of Missouri, College of Agriculture, Agricultural Experiment Station, Bulletin 662, October, 1955.

Mueller, A. G., "Detailed Cost Report for Northern Illinois, 1956," Department of Agricultural Economics, College of Agriculture, University of Illinois, Urbana, Illinois, Research Report AERR-21, March, 1958.

Appendix Table B.–Machinery Charges Used in Calculating Crop Costs[1]
(Based on size of machine and hours of use)

	Cost per hour when used						
Machine and size	20 hrs. per year	40 hrs. per year	60 hrs. per year	100 hrs. per year	150 hrs. per year	250 hrs. per year	350 hrs. per year
Tractor plow – 2-14"	$2.00	$1.05	$ .75	$ .50	$ .40	$ .37	$ .34
Tractor plow – 3-14"	3.10	1.65	1.20	.80	.60	.56	.54
Tractor plow – 4-14"	4.20	2.20	1.55	1.05	.85	.76	.72
Disk – 7 ft.	2.15	1.10	.75	.45	.35	.31	.29
Disk – 8 ft.	2.30	1.20	.80	.50	.38	.33	.31
Disk – 9 ft.	2.45	1.25	.85	.55	.40	.35	.33
Disk – 10 ft.	2.65	1.35	.95	.60	.44	.38	.36
Disk – 12 ft.	2.90	1.50	1.00	.65	.48	.42	.39
Disk – 14 ft.	3.10	1.60	1.10	.70	.50	.45	.42
Drag – 10 ft.	.24	.12	.08	.05	.04	.04	.04
Spike tooth harrow – 8 ft.	.25	.14	.09	.06	.05	.04	.04
Spike tooth harrow – 10 ft.	.35	.18	.12	.07	.06	.05	.05
Spike tooth harrow – 12 ft.	.40	.21	.15	.09	.07	.06	.06
Cultipacker – 7 ft.	1.15	.55	.40	.30	.27	.24	.23
Cultipacker – 8 ft.	1.25	.65	.45	.35	.30	.27	.25
Cultipacker – 9 ft.	1.40	.70	.50	.40	.33	.30	.28
Cultipacker – 10 ft.	1.55	.80	.55	.45	.37	.33	.31
Cultipacker – 12 ft.	1.80	.90	.60	.50	.42	.37	.35
Corn planter – 2 row	1.75	.90	.65	.55	.50	.45	.42
Corn planter – 4 row	3.35	1.75	1.20	1.00	.90	.85	.80
Grain drill – 12x7 in.	3.20	1.70	1.15	.95	.85	.80	.75
Grain drill – 13x7 in.	3.40	1.80	1.25	1.00	.90	.85	.80
Grain drill – 15x7 in.	3.80	2.00	1.35	1.10	1.00	.95	.90
Grain drill – 16x7 in.	4.00	2.10	1.45	1.20	1.10	1.00	.95
Grain drill – 17x7 in.	4.20	2.20	1.50	1.25	1.15	1.05	1.00
Meadow seeder – broadcast	.28	.15	.13	.11	.11	.10	.10
Rotary hoe – 2 row	1.30	.65	.45	.30	.25	.23	.21
Rotary hoe – 4 row	2.50	1.30	.85	.55	.48	.44	.41

Appendix Table B.—Continued—Machinery Charges Used in Calculating Crop Costs[1]
(Based on size of machine and hours of use)

	Cost per hour when used						
Machine and size	20 hrs. per year	40 hrs. per year	60 hrs. per year	100 hrs. per year	150 hrs. per year	250 hrs. per year	350 hrs. per year
Cultivator – 2 row	$2.10	$1.05	$ .75	$ .50	$ .35	$ .25	$ .23
Cultivator – 4 row	4.15	2.15	1.45	.95	.70	.50	.45
Sprayer – 6 row	1.12	.57	.39	.25	.18	.16	.15
Sprayer – 7 row	1.19	.61	.42	.26	.19	.17	.16
Sprayer – 8 row	1.27	.65	.45	.28	.20	.18	.17
Sprayer – 9 row	1.35	.69	.47	.30	.21	.19	.18
Corn picker – 1 row	10.20	5.25	3.60	2.25	1.60	1.40	1.25
Corn picker – 2 row	15.65	8.05	5.50	3.50	2.45	2.15	1.90
Combine, pull type – 5 ft.	13.40	6.90	4.70	3.00	2.10	1.60	1.50
Combine, pull type – 6 ft.	16.40	8.40	5.80	3.60	2.60	1.90	1.80
Combine, pull type – 7 ft.	22.40	11.50	7.90	5.00	3.50	2.60	2.50
Combine, self-propel – 9 ft.[2]	35.50	18.50	12.80	8.25	5.70	4.60	4.40
Combine, self-propel – 10 ft.[2]	41.60	21.70	15.10	9.75	7.10	5.50	5.20
Combine, self-propel – 12 ft.[2]	49.20	25.70	17.80	11.50	8.40	6.50	6.20
Mower – 7 ft.	2.70	1.40	1.00	.65	.50	.42	.40
Side delivery rake – 7 ft.	2.90	1.50	1.10	.70	.65	.60	.55
Hay baler – twine[3]	12.50	6.40	4.35	2.75	1.95	1.40	1.30
Hay baler – wire[3]	15.75	8.05	5.50	3.45	2.45	1.80	1.65
Elevator	2.80	1.45	1.00	.60	.55	.50	.45
Rotary mower	4.60	2.35	1.60	1.00	.75	.60	.55
Fertilizer and lime drill – 10 ft.	1.60	.85	.60	.50	.45	.40	.38
Fertilizer and lime drill – 12 ft.	1.85	1.00	.65	.55	.50	.45	.43

[1]Calculated from figures given in the following article: Richey, C. B., "Crop Machines Use," Agricultural Engineers' Yearbook, published by American Society of Agricultural Engineers, 1959 Edition, page 106.

[2]Includes gasoline and oil.

[3]Does not include cost of baling twine or wire.

Appendix Table C.–How Curves Were Determined in Figure 1
These curves were computed from equations determined by correlating crop costs with size of farm. The general formula used was;

$$Y = a + bX + cX^2$$

in which

Y equals cost per acre

and

X equals the number of crop acres

Values for a, b, c, Sy and R are as follows:

Y	a	b	c	Sy	R
Corn	65.14	-.03327[1]	+.0000228[1]	3.17	.68
Soybeans	50.51	-.02895[1]	+.0000195[3]	3.02	.65
Wheat	50.20	-.01845[1]	+.0000116[4]	2.77	.53
Hay	41.52	-.01892[2]	+.0000145[4]	3.46	.40

[1]Significant at .1 percent level.

[2]Significant at 1 percent level.

[3]Significant at 2 percent level.

[4]Significant at 5 percent level.

Appendix Table D.–Annual Use of Corn Picker, Combine and Hay Baler on 87 Farms, West Central Ohio, 1958

	Size of farm in crop acres			
	51-141 (21 farms)	142-207 (22 farms)	208-347 (22 farms)	348-996 (22 farms)
Number of farmers using corn picker				
Less than 50 hours a year	5	2	0	0
Less than 75 hours a year	10	6	3	0
More than 100 hours a year	4	8	10	19
More than 150 hours a year	2	4	5	12
Number of farmers using combine				
Less than 50 hours a year	10	5	2	0
Less than 75 hours a year	11	10	9	5
More than 100 hours a year	2	3	6	12
More than 150 hours a year	1	1	0	3
Number of farmers using hay baler				
Less than 50 hours a year	6	7	3	6
Less than 75 hours a year	8	12	10	11
More than 100 hours a year	0	0	2	2
More than 150 hours a year	0	0	0	0
Number of farmers hiring corn picked	2	2	2	0
Number of farmers hiring grain combined	5	3	0	0
Number of farmers hiring hay baled	11	8	10	4

Appendix Table E.–Annual Use of Tractors[1] on 124 Farms, West Central Ohio, 1958

	Size of farm in crop acres			
	50-141 (30 farms)	142-206 (31 farms)	207-363 (31 farms)	364-966 (30 farms)
Number of farmers using tractors				
300 hours a year[2]	12	5	3	2
350 hours a year	11	9	3	6
400 hours a year	2	9	7	5
450 hours a year	3	1	5	2
500 hours a year	2	5	8	3
550 hours a year	0	0	1	5
600 hours a year	0	0	4	4
700 hours a year	0	1	0	2
800 hours a year	0	1	0	1

[1] In terms of tractor equivalents:
Tractors less than 13 years old were rated as 1 tractor.
Tractors 13 to 16 years old were rated as one-half of a tractor.
Tractors 17 to 20 years old were rated as one-fourth of a tractor.
Tractors 21 years old and over were rated as one-tenth of a tractor.

[2] Tractor use rounded to nearest 50 hours.

Appendix Table F.–Calculated Costs of Producing Corn on Different Size Farms with and without Custom Work, West Central Ohio, 1958 (Based on a 75 bushel yield)

	160-acre farm		280-acre farm	500-acre farm
	No machine work hired	Corn picking hired[1]	No machine work hired	No machine work hired
Man labor	$11.10	$10.00	$10.70	$ 7.70
Tractor power	6.50	5.55	6.35	5.60
Machinery	10.25	6.90	7.20	6.85
Fertilizer	10.95	10.95	10.95	10.95
Manure	5.20	5.20	5.20	5.20
Lime	.50	.50	.50	.50
Seed	1.80	1.80	1.80	1.80
Spray	.30	.30	.30	.30
Land	16.50	16.50	16.50	16.50
Total	63.10	57.70	59.50	55.40

[1] Custom rate used for picking was $5.00 an acre.

Appendix Table G.--Calculated Costs of Producing Soybeans on Different Size Farms with and without Custom Work, West Central Ohio, 1958 (Based on a 30 bushel yield)

	160-acre farm		280-acre farm	500-acre farm
	No machine work hired	Combining hired[1]	No machine work hired	No machine work hired
Man labor	$ 9.15	$ 8.40	$ 8.50	$ 6.00
Tractor power	5.70	4.95	5.35	4.10
Machinery	8.75	7.35	6.80	7.85
Fertilizer	3.00	3.00	3.00	3.00
Manure	1.20	1.20	1.20	1.20
Lime	.50	.50	.50	.50
Seed	3.10	3.10	3.10	3.10
Land	16.50	16.50	16.50	16.50
Total	47.90	45.00	44.95	42.25

[1]Custom rate used for combining was $5.50 an acre.

Appendix Table H.--Calculated Costs of Producing Wheat on Different Size Farms with and without Custom Work, West Central Ohio, 1958 (Based on a 30 bushel yield)

	160-acre farm		280-acre farm	500-acre farm
	No machine work hired	Combining hired[1]	No machine work hired	No machine work hired
Man labor	$ 5.50	$ 4.75	$ 5.20	$ 3.95
Tractor power	3.25	2.50	3.20	2.30
Machinery	7.30	5.85	5.25	6.30
Fertilizer	6.15	6.15	6.15	6.15
Manure	2.50	2.50	2.50	2.50
Lime	.50	.50	.50	.50
Seed	4.95	4.95	4.95	4.95
Land	16.50	16.50	16.50	16.50
Total	46.65	43.70	44.25	43.15

[1]Custom rate used for combining was $5.00 an acre.

Appendix Table I.—Relationship between Size of Fields and Amount of Time Required to Do Certain Jobs, West Central Ohio, 1958

Job	Number of cases	Size of field acres	Man-hours used	Tractor hours used
Plow – 2-14" plows	9	8-15	1.31	1.31
Plow – 2-14" plows	16	24-50	1.25	1.25
Plow – 3-14" plows	7	10-15	.93	.93
Plow – 3-14" plows	31	25-50	.87	.87
Plant corn – 2 rows	14	8-15	.60	.60
Plant corn – 2 rows	23	20-50	.58	.56
Plant corn – 4 rows	14	11-20	.35	.32
Plant corn – 4 rows	27	30-50	.33	.27
Pick corn – 1 row	7	10-15	1.56	1.56
Pick corn – 1 row	13	19-35	1.72	1.65
Pick corn – 2 rows	15	8-18	.92	.91
Pick corn – 2 rows	33	26-50	.86	.84

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